Effective PBLs Through Simultaneous Optimization and Simulation of Maintenance, Manpower, and Spare Parts

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Performance Based Logistics Contract Implementation

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Effective PBLs Through Simultaneous Optimization and Simulation of Maintenance, Manpower, and Spare Parts

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Performance Based Logistics (PBL)

- The US DoD's preferred support strategy for weapons systems.
- Seeks to deliver product support as an integrated, affordable performance package designed to optimize system readiness.
- …long-term performance agreements with clear lines of authority and responsibility.
- …strategies should optimize total system availability while minimizing cost and logistics footprint...
- The selection of the specific performance metrics should be carefully considered and supported by an operationally-oriented analysis.

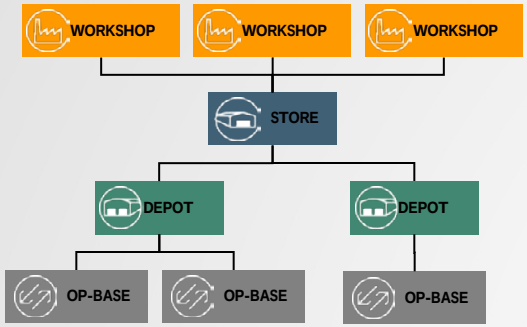
Ref. US DoD Directive 5000.01

Modeling Logistics Support

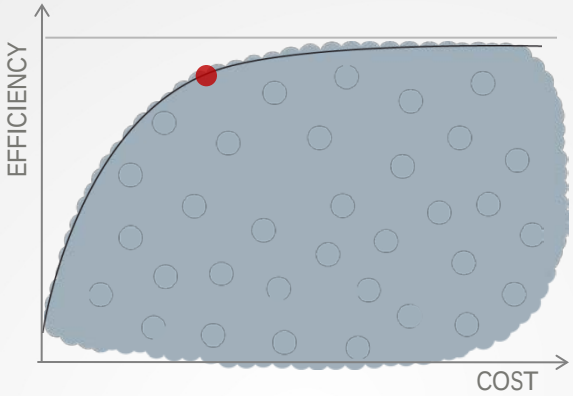
- As usual, the overall objective is an effective solution at an acceptable cost
  - Requires a systems and fleet level approach to show the relative contribution of all product support elements on fleet/mission/system capability
- Two or more organizations involved – increased risk for:
  - Different side-objectives
  - Inefficiency due to misunderstandings, mistakes, delays, etc
- Contractual Agreement
  - Direction, follow up and control
  - Clarity and simplicity
  - Right target parameters
  - Right requirement levels
  - Incentive models (penalties or rewards)

Optimal Balance Between Operational Performance and Overall Cost

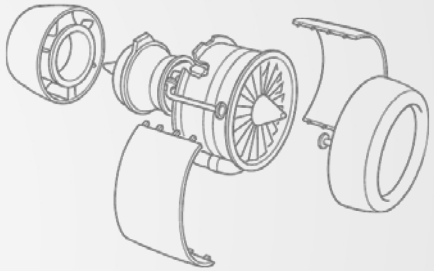
SUPPORT SOLUTION



- Support Structure
- Facilities
- Transportation
- Personnel
- Support & Test Equipment
- Tech Doc
- Spares
- Logistic Delay Times

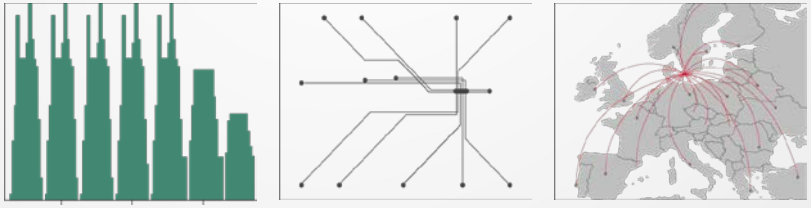


TECHNICAL SYSTEM



- Product Structure
- Reliability
- Maintainability
- Maintenance plan
- Repairable/Discardable items
- Status

OPERATION



- Number of systems
- Deployment
- Operational Profile
- Operating Environment

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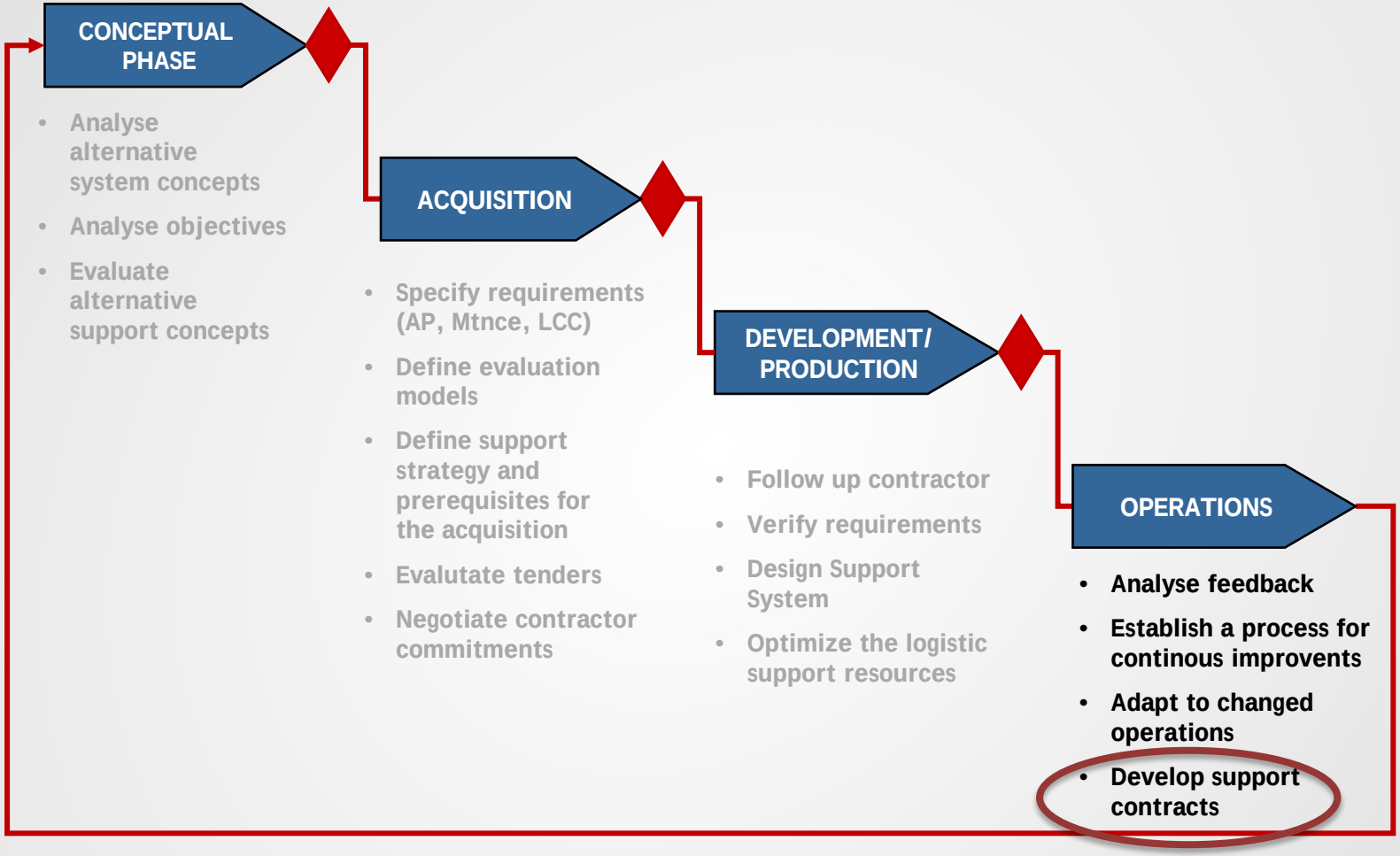
CORE LIFE-CYCLE MANAGEMENT ACTIVITIES WHERE OPUS SUITE PROVIDE DECISION SUPPORT



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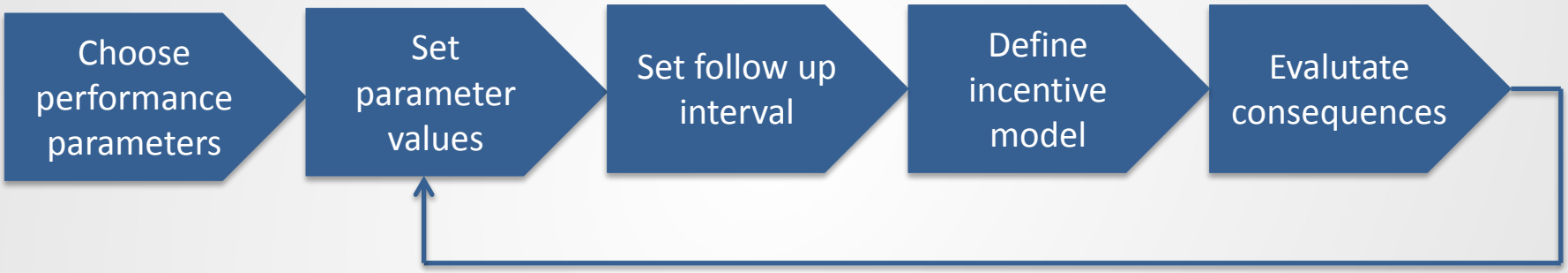
Setting targets for contracts



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What is the contract scope?

Spare parts

(prices, delivery times)

Component Repair & Overhaul

(Turn around Times, task prices)

Component supply

(Backorders, waiting times, fill rate)

Logistic Support

(System down time)

System supply

(Availability, Power by the hour)

Functional leasing

(Readiness, Power by the hour)

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Successful PBL contracts

- The customer wants to
  - secure that the operational needs will be met without risking to pay too much
  - control cost
- The supplier wants to
  - assess the resources needed to fulfill the commitment
  - reduce risks
  - minimize cost
- Success if we can create a contract that drive a Win-Win situation
- A complex problem
  - need for an good methodology
  - need for proper decision support

Decision support

- Simulation
  - Simulate the operational performance that the customer will achieve given a certain contractual agreement
  - Evaluate the probability of meeting the performance level given a certain logistics solution.
  - Generate statistics concerning the inherent variations of the logistic parameters, this should be used when formulating the contract terms

- Optimization
  - Determine the most cost effective manpower, support equipment and spare parts solution to meet the objectives
  - Calculate the logistics support cost to reach a certain performance level


Choose performance parameters
Set parameter values
Set follow up interval
Define incentive model
Evalutate consequences

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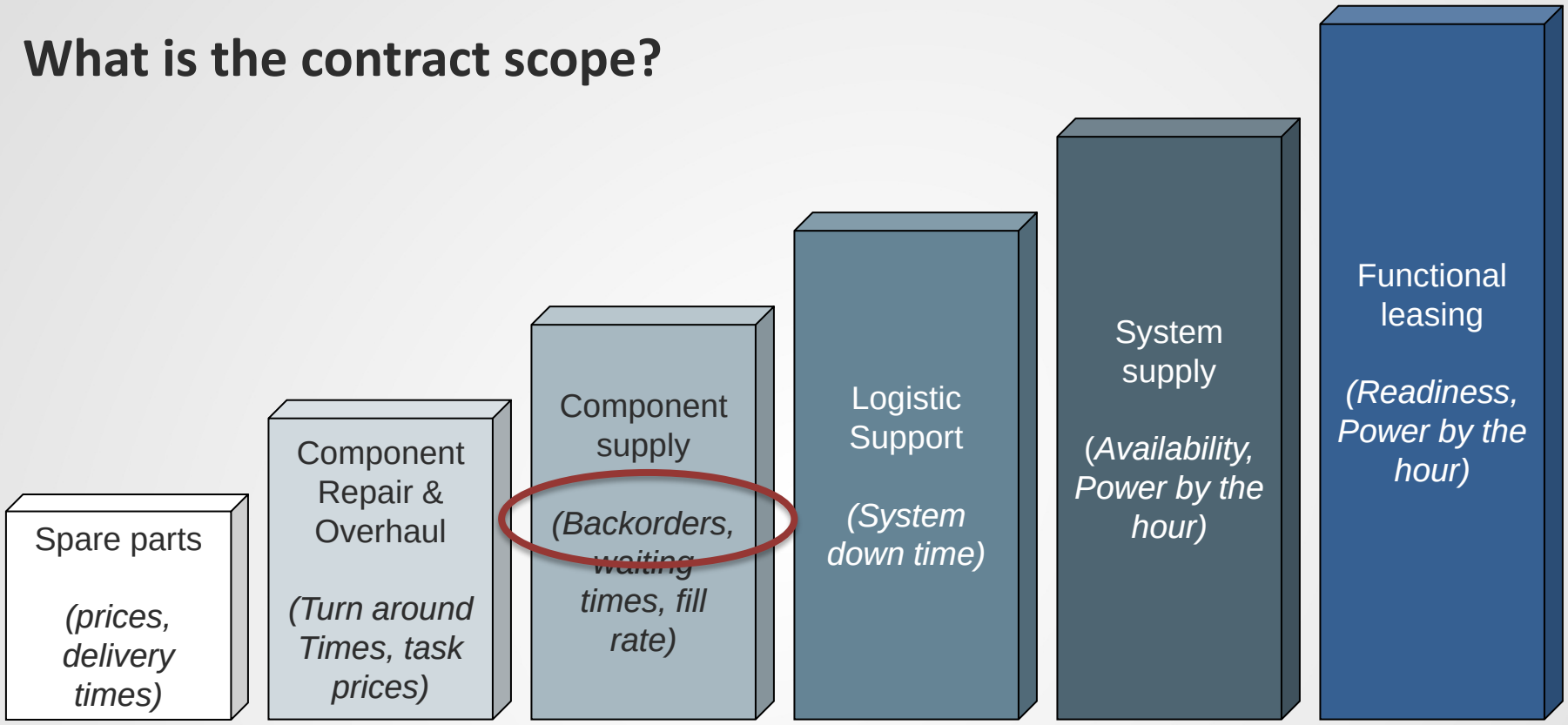
Example

What is the contract scope?



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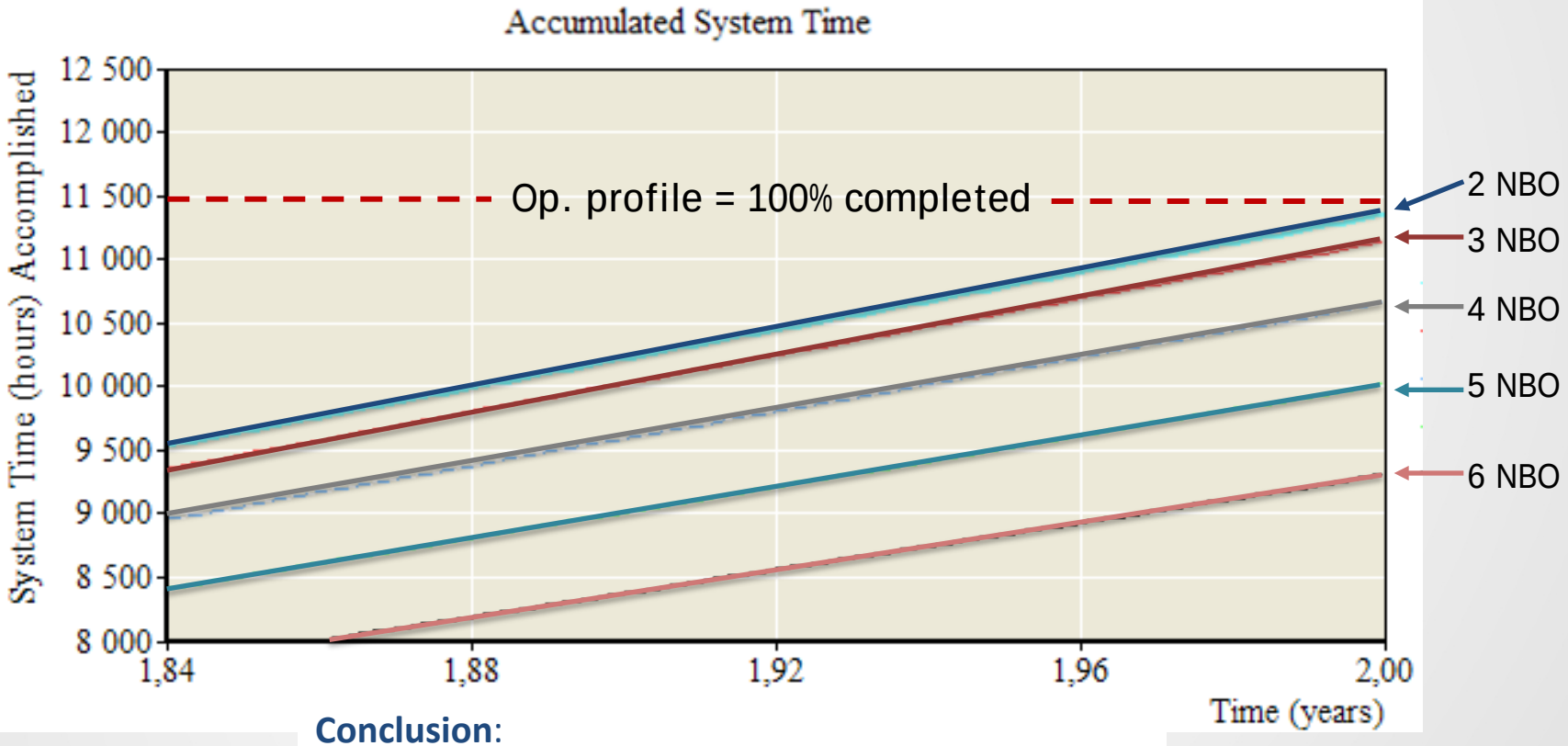
Simulation of PBL Target Levels

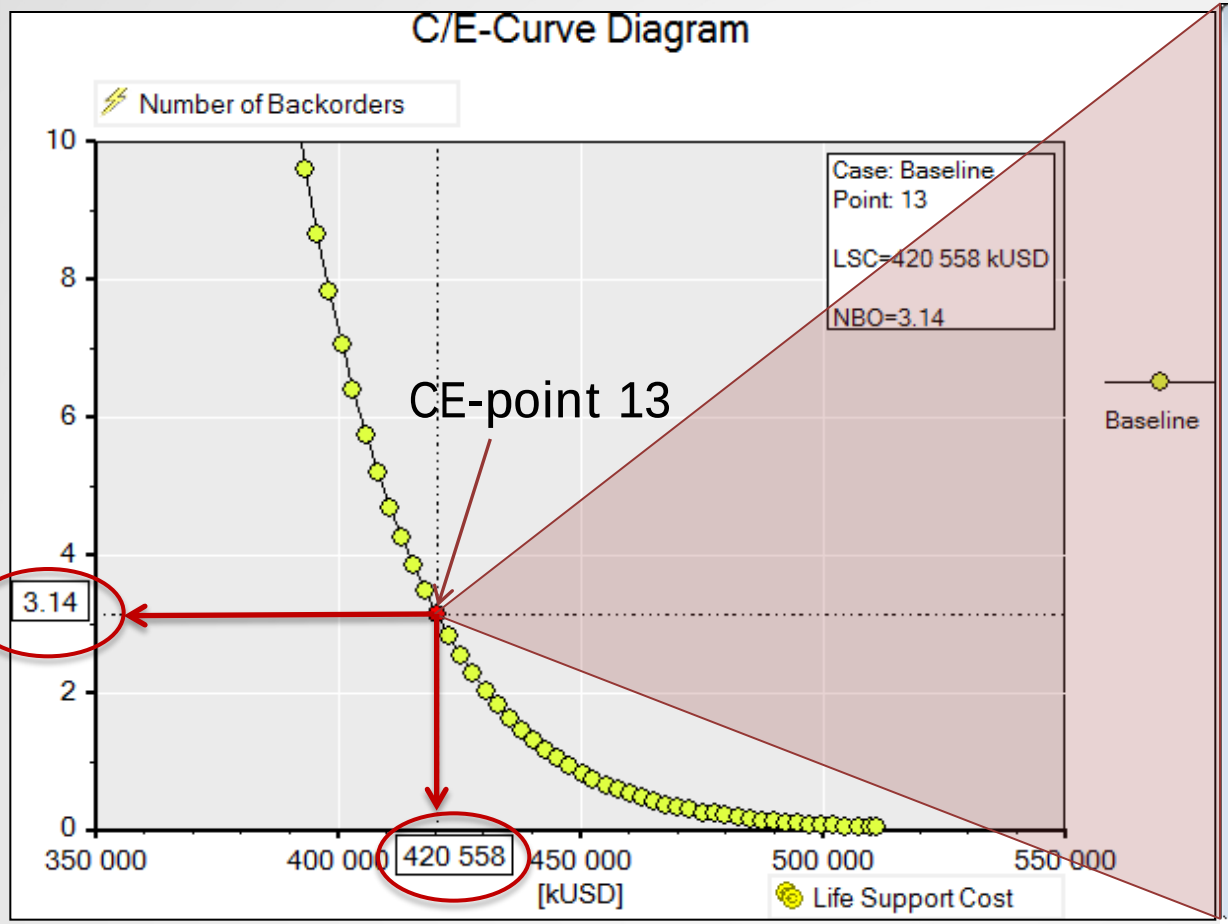


Conclusion:

- 2 Backorders don't influence operations at all
- 3 Backorders is acceptable!
- 4 Backorders limit operational capability
- 5 Backorders is not acceptable

Example

Spares optimization – Baseline



Report Window (Baseline.opo) <Stock_ItemStation (POINT: 13)>

STSIZ / Station: Stock allocation

	IID: Item identifier	STID: Station identifier QTY: Total number of each station STORE
1	LRU1	3
2	LRU2	4
3	LRU3	3
4	LRU4	4
5	LRU5	5
6	LRU6	6
7	LRU7	1
8	LRU8	7
9	LRU9	3
10	LRU10	3
11	LRU11	3
12	LRU12	4
13	LRU13	5
14	LRU14	2
15	LRU15	5
16	LRU16	4
17	LRU17	2
18	LRU18	3
19	LRU19	2
20	LRU20	3
21	LRU21	2
22	LRU22	6

Optimized stock to be used in the simulations

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Choose performance parameters
Set parameter values
Set follow up interval
Define incentive model
Evalutate consequences

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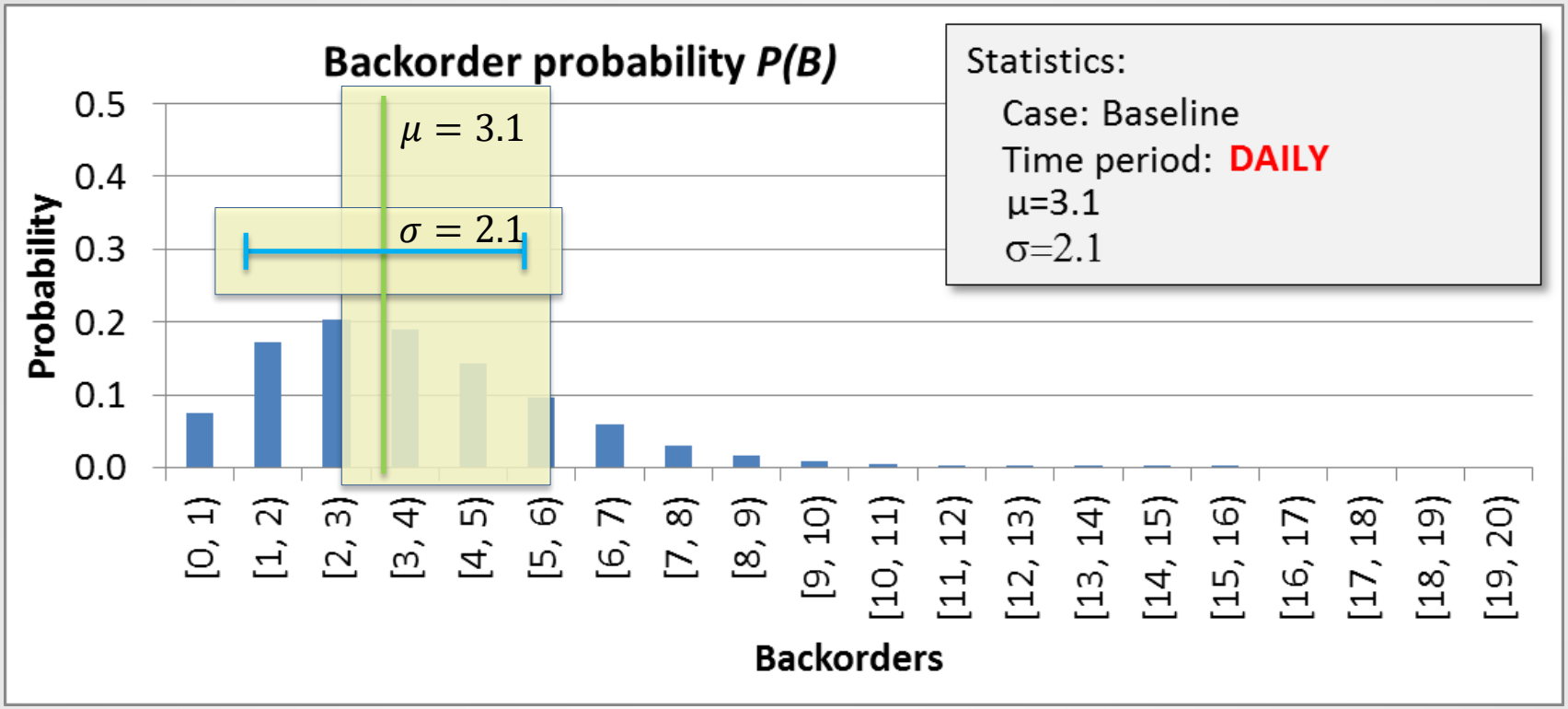
Measurement interval

Choose performance parameters → Set parameter values → Set follow up interval → Define incentive model → Evalutate consequences



- Graph generated from SIMLOX simulation data covering a period of 1000 years (100 replications)

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Choose performance parameters
Set parameter values
Set follow up interval
Define incentive model
Evalutate consequences

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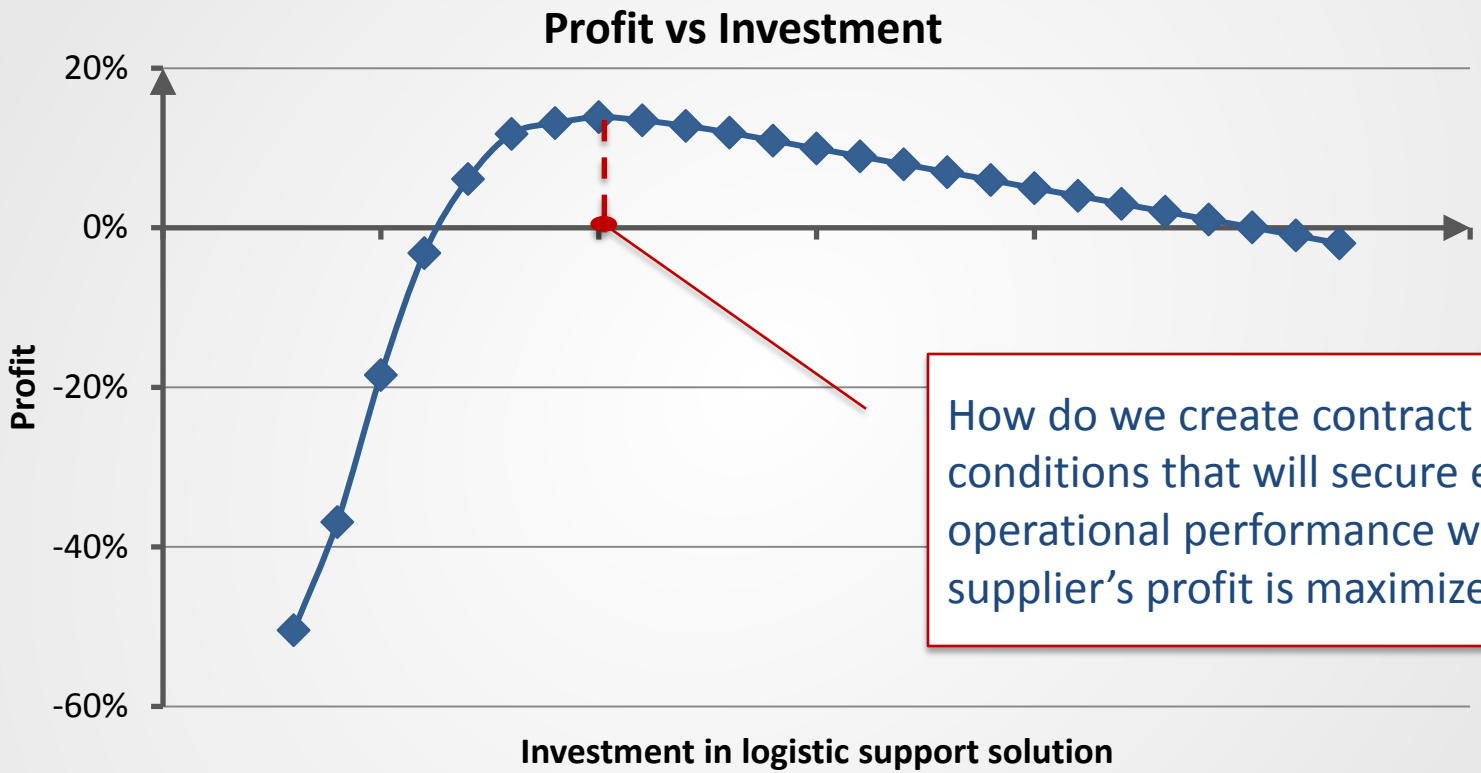
Defining the incentive model



How do we create contract conditions that will secure enough operational performance when the supplier's profit is maximized?

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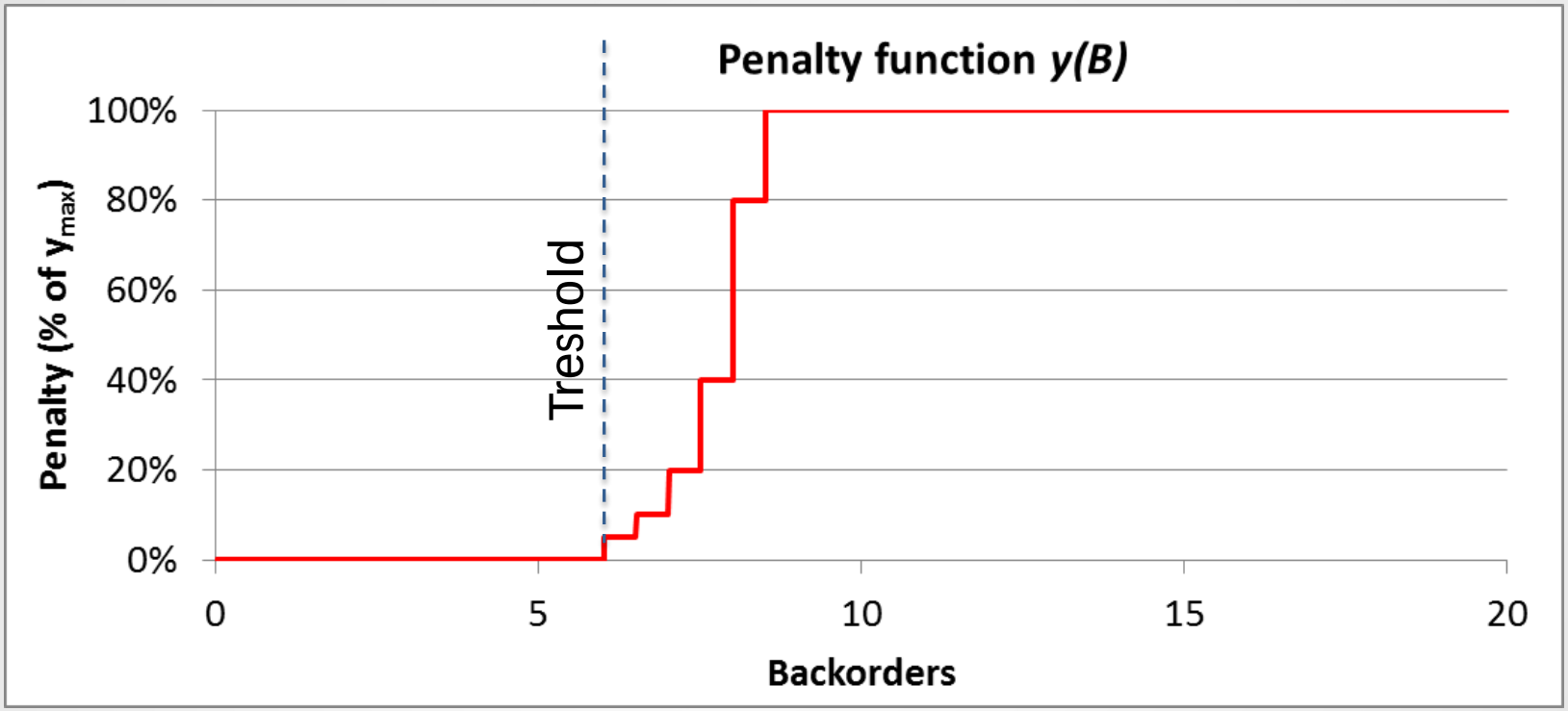
Example

Penalty function



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Choose performance parameters
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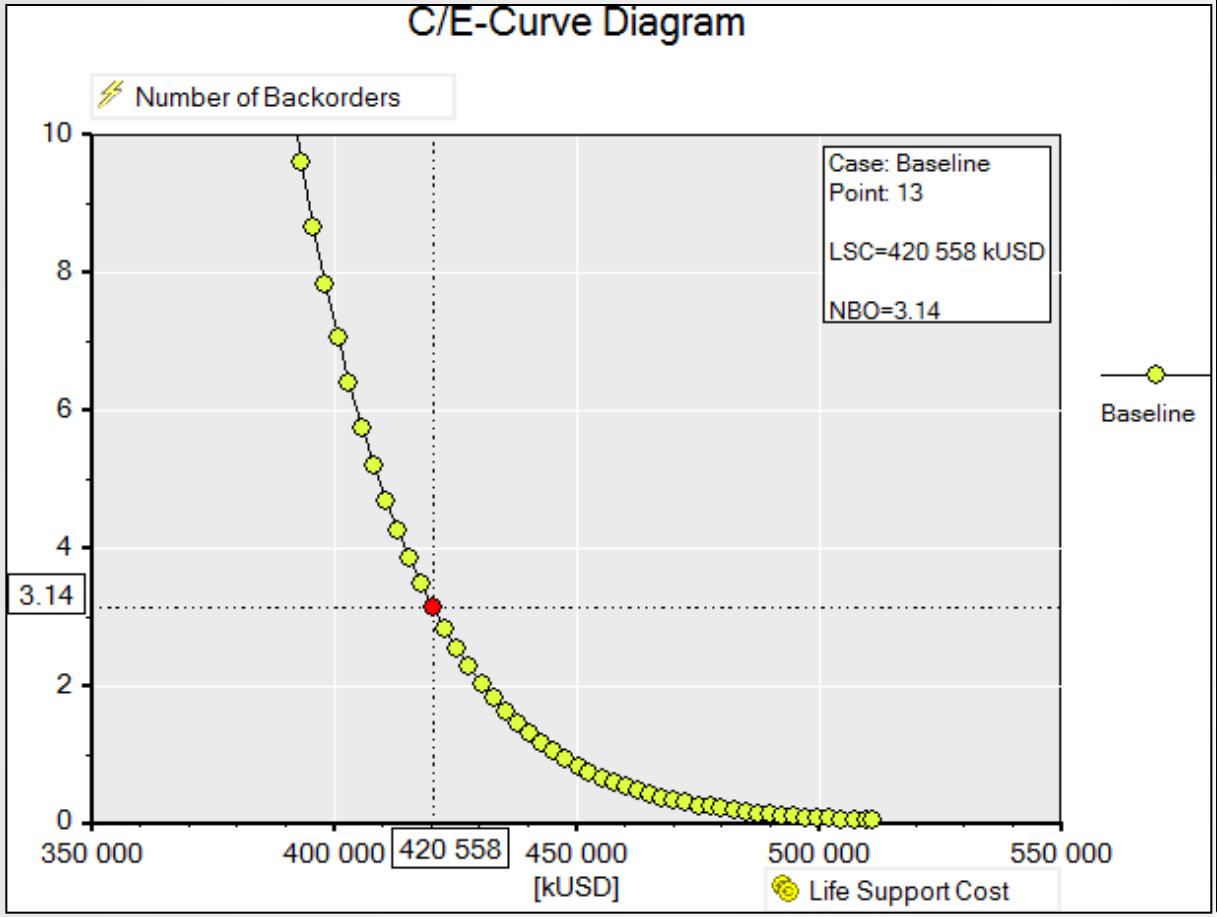
Example

Spares optimization – Baseline



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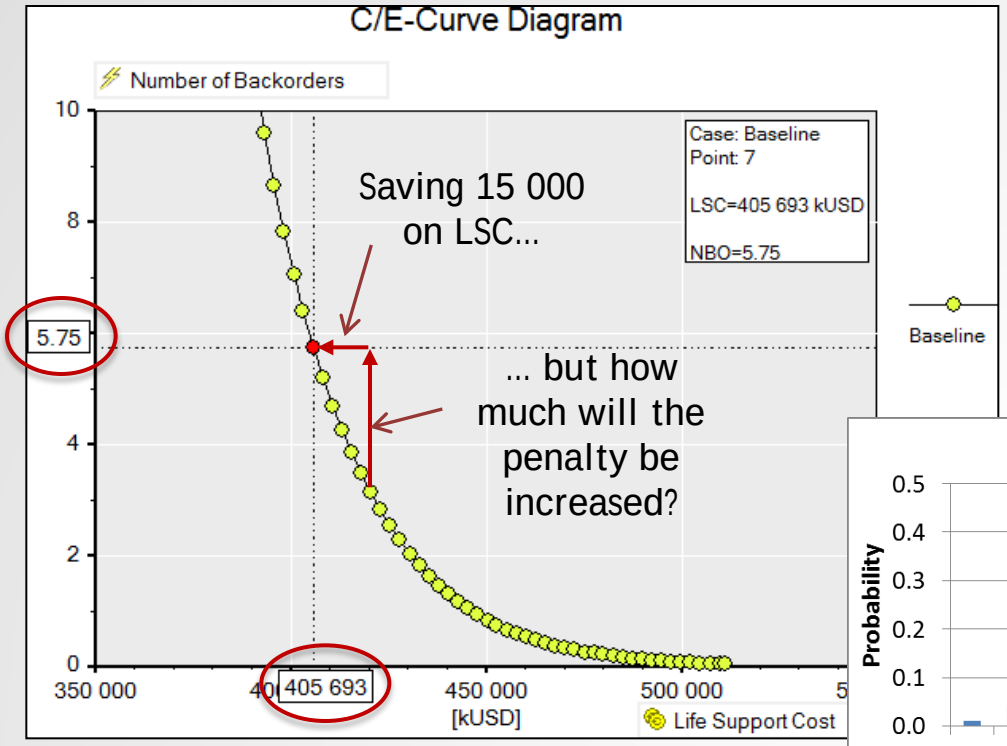
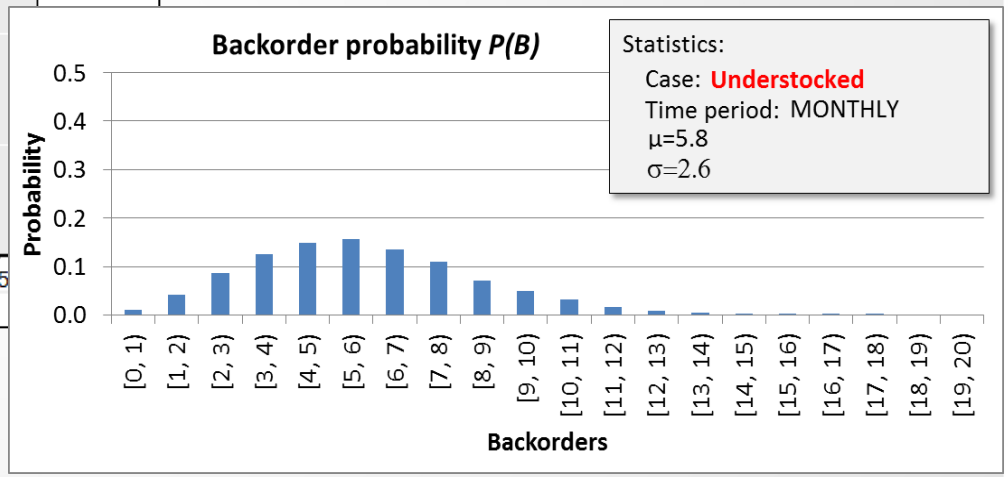
Example

Understocked scenario





Average monthly penalty = 22%

Almost a 10-fold increase in penalties => 110 MUSD (over 10 years) .

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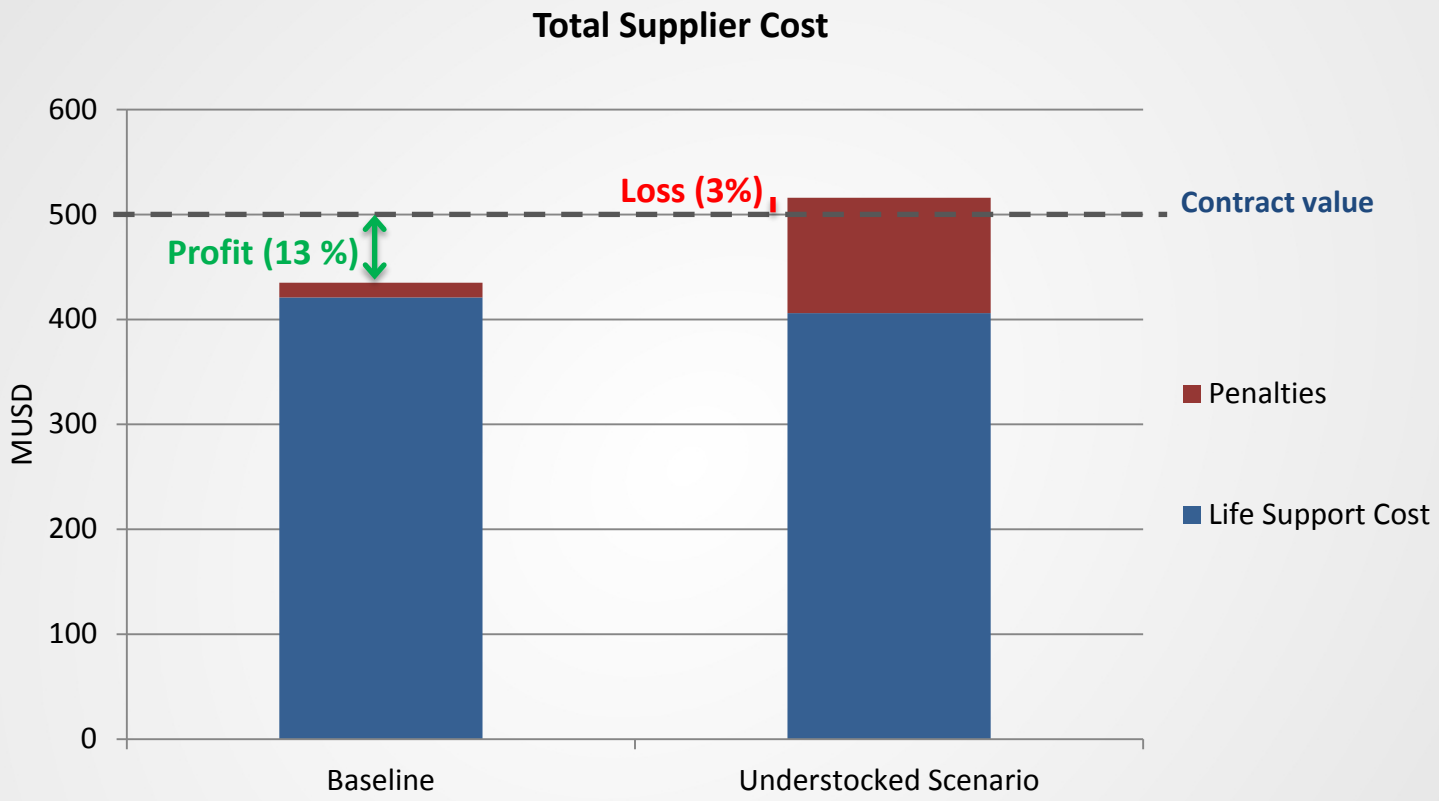
Example

Supplier Cost Calculation



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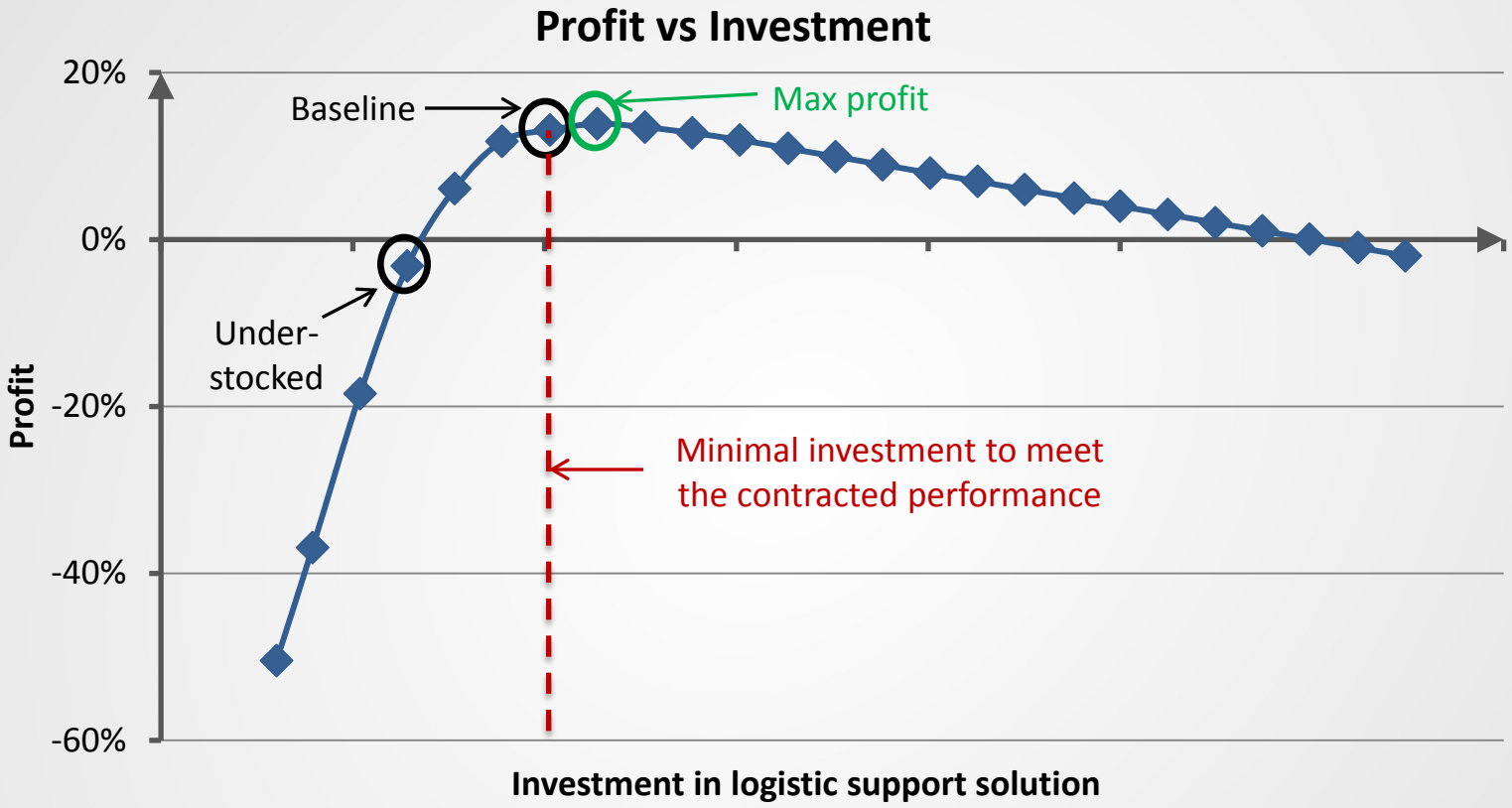
Example

The complete curve…



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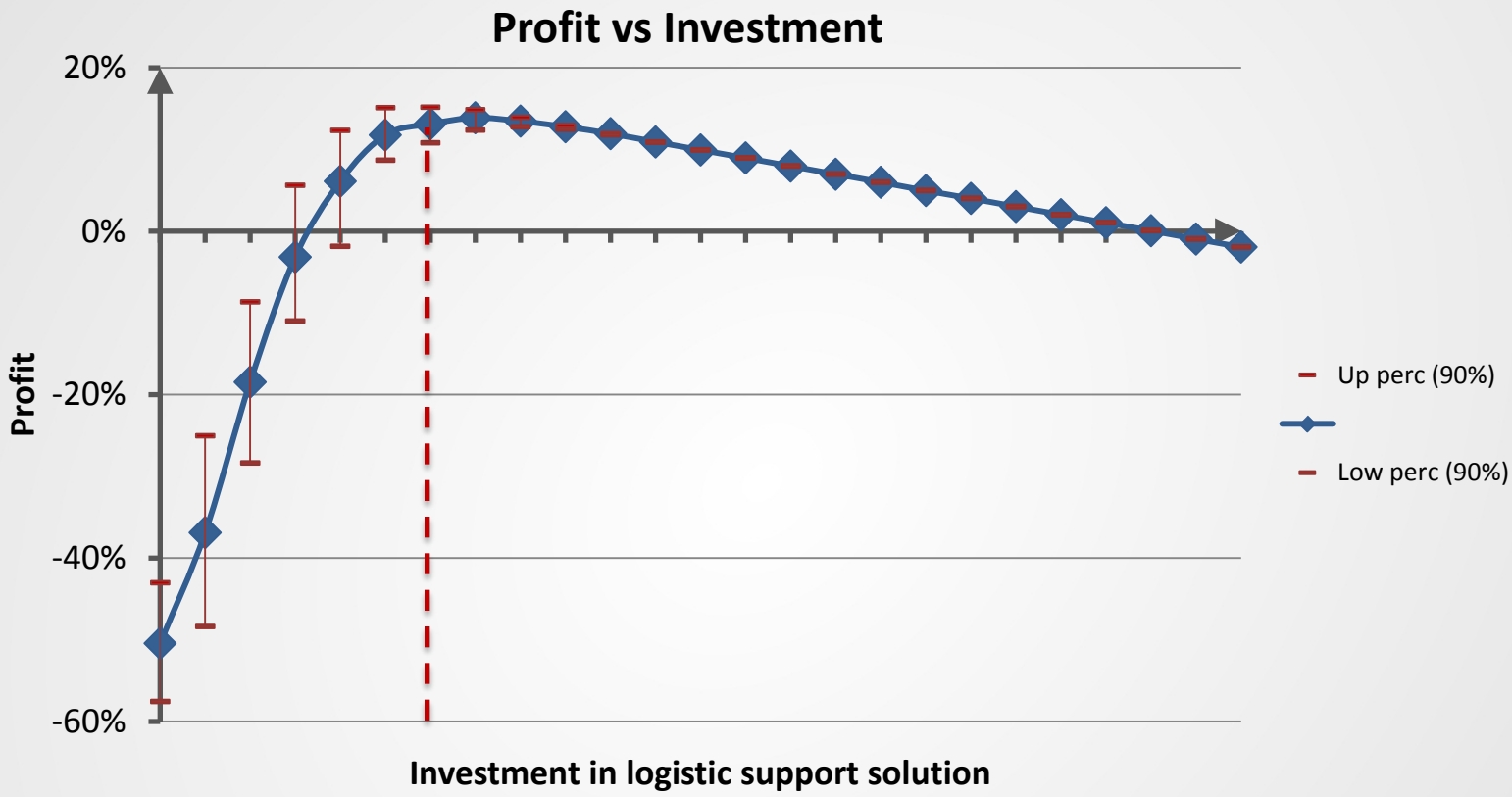
Example

Also assess the variation



A small extra investment creates robustness towards variation and thus lowers the penalties

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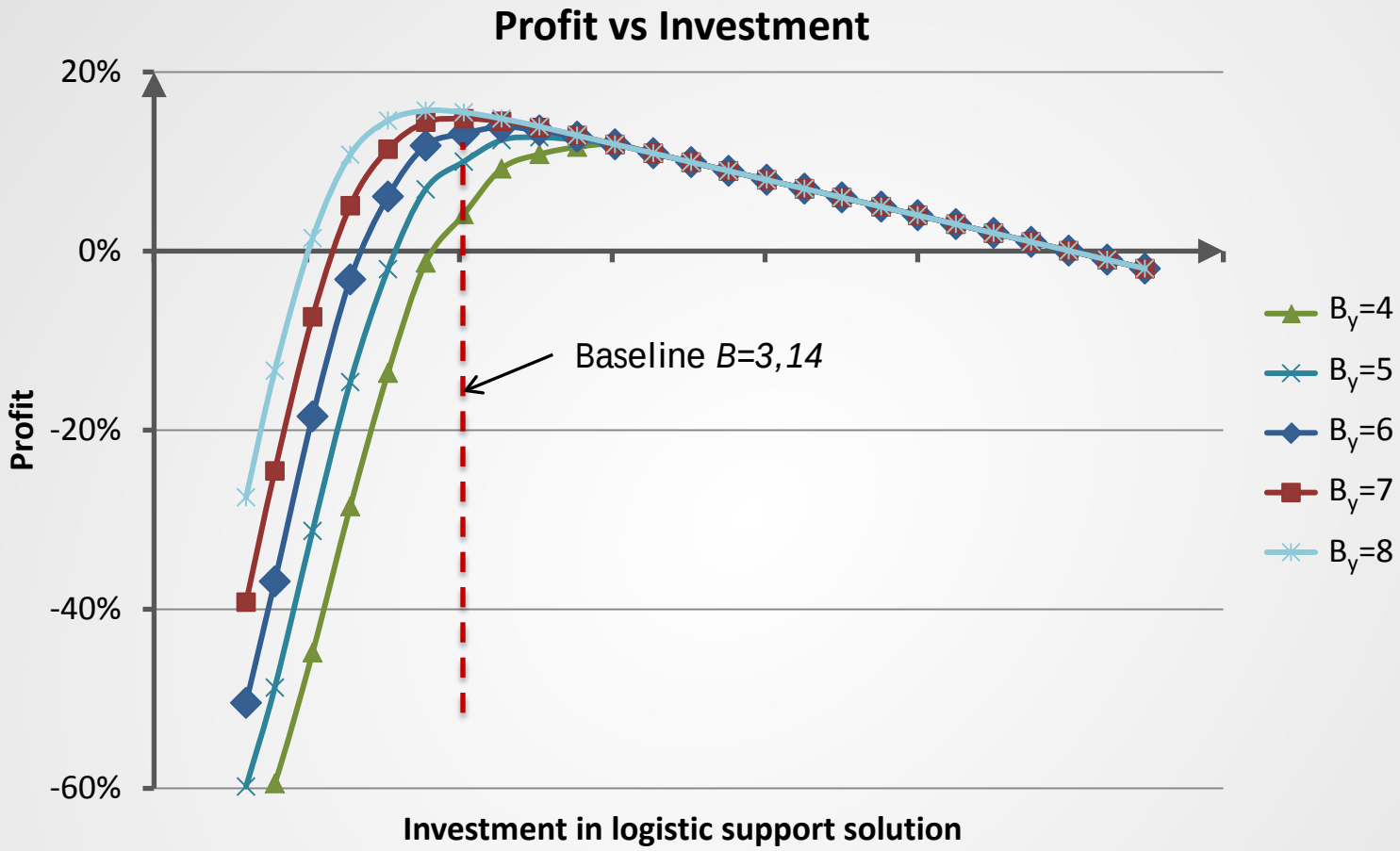
Study alternative penalty functions

Example



- Lowering the threshold will encourage overstocking
- Increasing the threshold will encourage understocking

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Reference Projects - Performance based logistics

- Swedish Defense NH90
- BAE Systems Combat Vehicle 90
- Saab Dynamics Med Range Air Def System
- F-35 JPO Joint Strike Fighter

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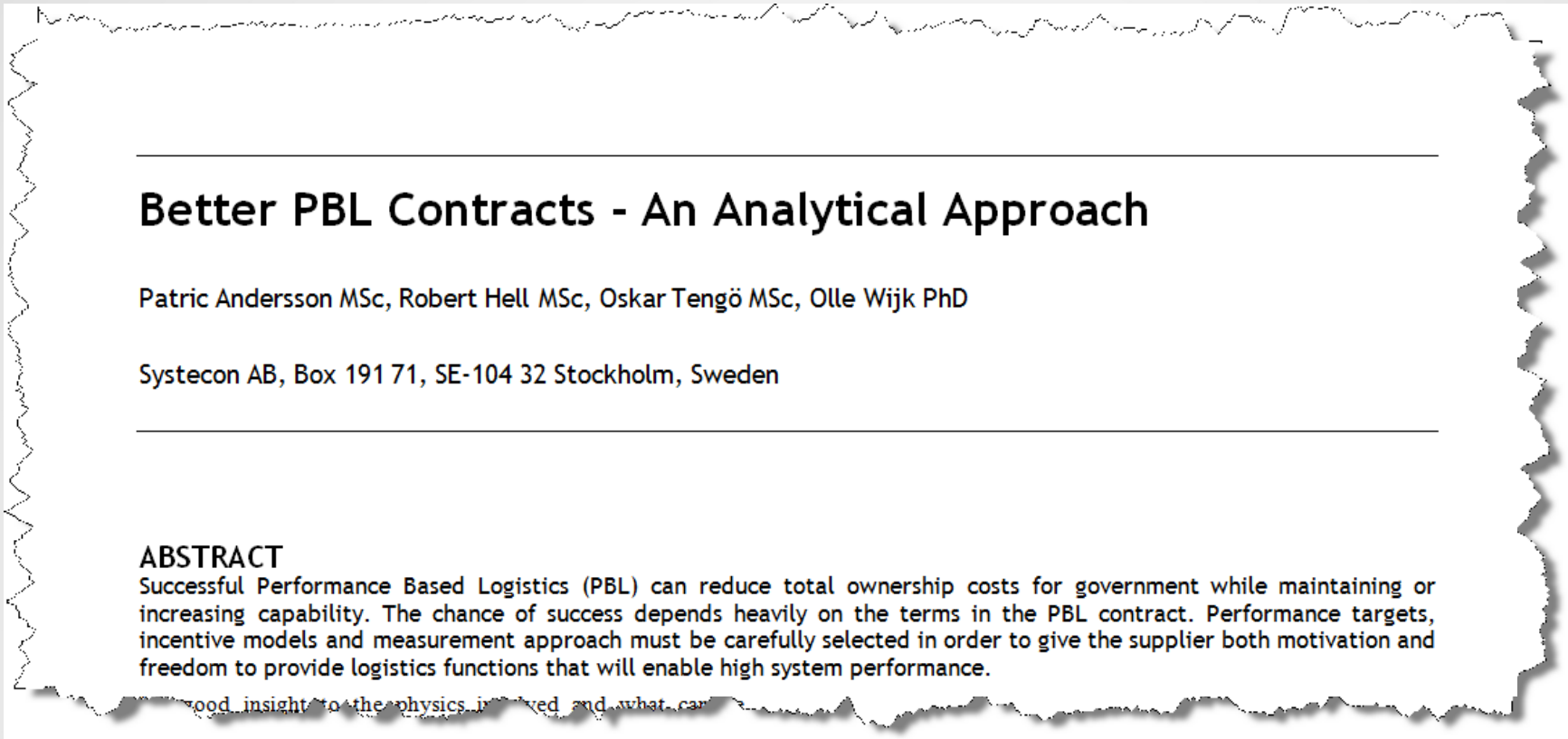
Summary

- Modeling & simulation are essential in understanding the consequences of contract parameters and in designing contract terms that gives the supplier incentives to meet the objectives
- If not taking into account the inherent variations there is a risk that cost-inefficient support strategies are implemented
- The proposed method provides a decision maker with better decision support
- The method makes it easy for both customers and suppliers to evaluate contract and assess the risks for not meeting the contract objectives.
- When dimensioning one aspect of the PBL contract it is critical to be able to measure the impact of all others on the fleet readiness objective. A common method for parts, performance, manpower and support equipment is required.
- The tools can also be used by the supplier to design and optimize the logistic support solution

For a more complete description:



Better PBL Contracts - An Analytical Approach

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ABSTRACT

Successful Performance Based Logistics (PBL) can reduce total ownership costs for government while maintaining or increasing capability. The chance of success depends heavily on the terms in the PBL contract. Performance targets, incentive models and measurement approach must be carefully selected in order to give the supplier both motivation and freedom to provide logistics functions that will enable high system performance.

The paper is available at US Defense Acquisition University's homepage, under heading PBL Articles and Reports: https://acc.dau.mil/adl/en-US/550403/file/68281/PAPER_BetterPBLContracts_AnAnalyticalApproach.pdf

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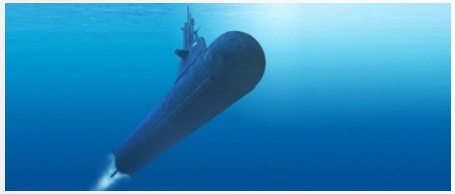

Thank you
for
your attention!

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